Overview of Private Sector Approaches for Estimating Traffic Flow using Aerial Photography

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National Consortium on Remote Sensing in Transportation (NCRST)

- Four consortia
  - NCRST-DASH (Safety, Hazards and Disaster Assessment – New Mexico, Utah, George Washington, Oak Ridge National Labs)
  - NCRST-E (Environment – Miss. State, Alabama, Auburn, Ole Miss.)
  - NCRST-F (Flows – OSU, GMU, UA)
  - NCRST-I (Infrastructure – UCSB, UW, ISU, UF)
- Project supported by a grant through NCRST-F
- www.ncrst.org

Traffic Flow

- Fundamental to understanding travel
- Measures
  - Speed
  - Average running speed
  - Volume
  - Rate of flow (vehicles per hour)
  - Density (vehicles per mile per lane)
  - Capacity
  - Level of service
    - ⇒ qualitative interpretation and/or measure of the effects of many performance related factors (speed, travel time, traffic interruptions, safety, comfort, operating costs, volume-to-capacity ratios, etc.)

Congestion

- Acute problem in urban regions
- Flow and capacity dictate whether congestion exists
- Range of impacts of congestion
  - traffic delays, schedule slippage, production interruptions, wasted fuel, environmental damage, etc.
- Costs associated with congestion
  - hundreds of billions of dollars in the United States alone

Planning and Decision Making

- Accurate and up-to-date information needed
- Investment decisions and policy making
- Managing congestion
- Coordinating expansion, renovation and/or extension to roadways
- Typical traffic flow conditions vs. individual/group perceived

What to monitor?

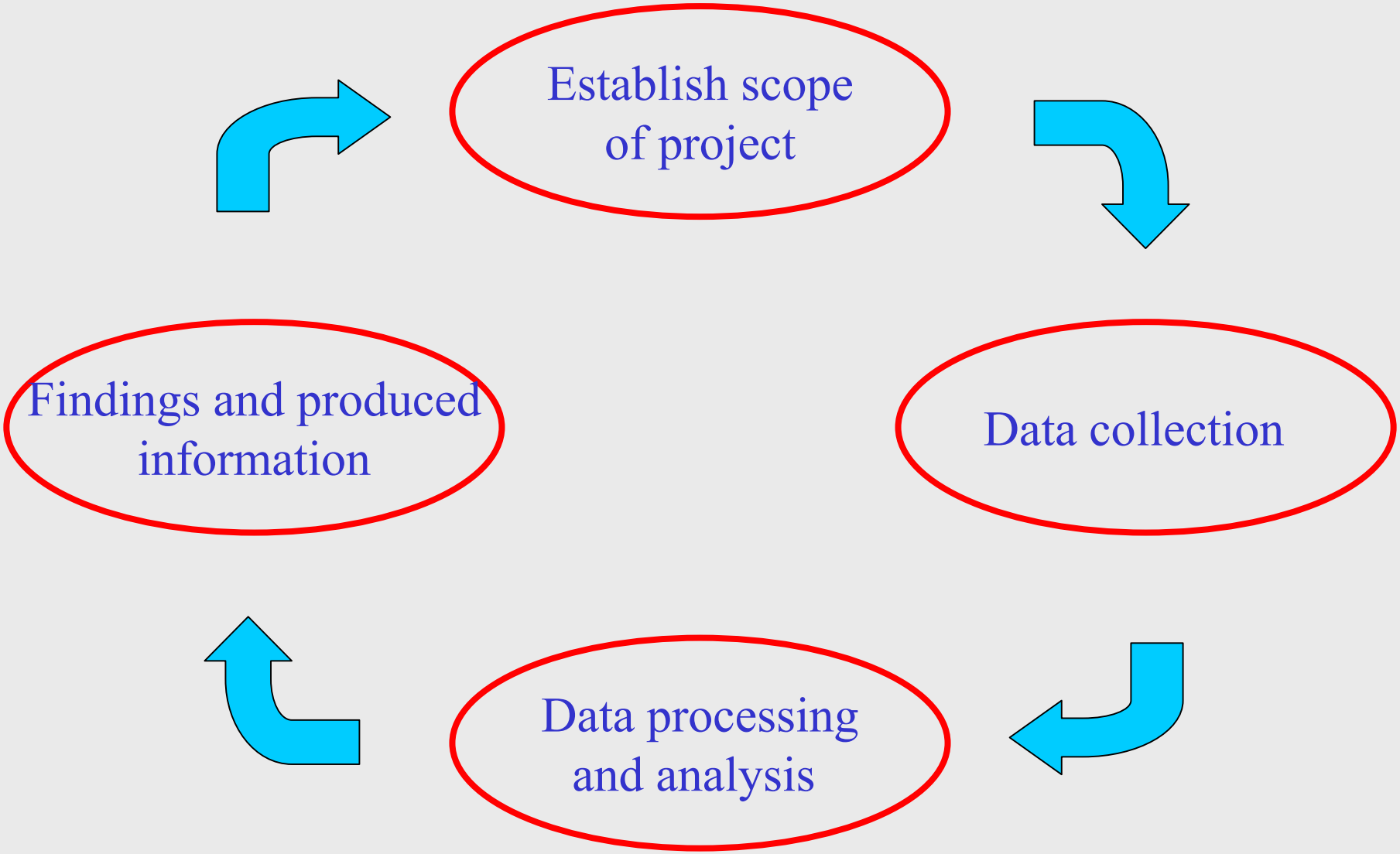
- Points
  - intersections, toll plazas, bus stops, etc.
- Segments
  - uniform linear portions of roadway
- Facilities
  - roadways, paths, routes, etc.
- Corridors
  - two or more facilities
- Regional system

Zegeer, J.D. (1999). “Planning approach to capacity.” In Transportation Planning Handbook, 2nd Edition, edited by J.D. Edwards, 207-238 (Washington, D.C.: Institute of Transportation Engineers).

Aerial Photography / Photogrammetry

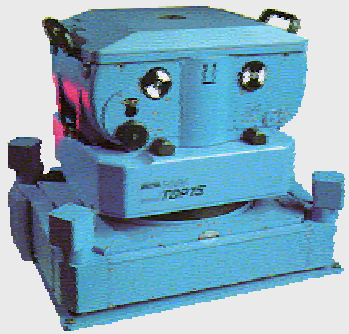
- Long history of use in monitoring traffic flow
  - Johnson, A.N. (1928). “Maryland aerial survey of highway traffic between Baltimore and Washington.” Highway Research Record 8, 106-115
  - Treiterer, J. and Taylor, J.I. (1966). “Traffic flow investigation by photogrammetric techniques.” Highway Research Record 142, 1-12.
- Flexible and cost effective approach
- Safe, unobstructed view
- Broad spatial coverage
- Uses
  - derive segment/usage counts
  - estimate travel speeds
  - characterize traffic flow
  - assess regional performance

Implementing a Traffic Flow Study



Details

- Helicopters and fixed-wing aircraft
  - unobstructed view
  - mobility
- Altitudes
  - varies depending upon weather conditions, area(s) being studied, and monitoring purpose
  - typically 5000-7500 ft.
- Documenting conditions
  - quantitative
  - qualitative
- Equipment
  - mounted
  - unmounted



Aerial Survey Information

- Four basic components
  - determining travel speed
  - vehicle counts by segment
  - documentation of observed flow
  - qualitative assessment of travel conditions (facility based and system wide)
- Travel speeds / times
  - tracking selected vehicles using sequenced time-stamped aerial photographs along specified roadway segments (indicating vehicle entrance and exit times as well as distance)
  - geo-registered aerial photograph pairs
  - combine densities with ground-based volumes

Documentation and Counts

- Facilities
  - roadway segments
  - intersections, ramps, bridges, toll plazas, airports, etc.
- Aerial photography
  - analysis of photographs and/or negatives using light tables or more sophisticated photogrammetric equipment
  - documentation of observed conditions

Traffic Flow Conditions

Processing Issues

- Determining capacities
- Counts by segment
- Deriving speeds
- Conversion to common vehicle type

Vehicle type	Passenger-car equivalent
Cars	1
Recreational vehicles	1.2
Trucks and buses	1.5

Reporting Information

- Depends on roadway type (freeway, highway, urban street, intersection, etc.) and intent of study
  - varying speed limits, interrupted/uninterrupted flow, capacities, etc.
- Many potential methods
  - tabular, photograph, illustrative/graphic, summary, video, etc.
- Often quality of service and level of service has been primary objective
  - describing operational conditions of roadways in terms speed and travel time, freedom to maneuver, traffic interruptions, and comfort and convenience

Level of Service

Type	Measure of effectiveness
Freeways	
Basic segment	Density (pc/mi/ln)
Weave segment	Density (pc/mi/ln)
Ramp junction	Density (pc/mi/ln)
Facility	Average travel speed (mph)
Multi-lane highways	Density (pc/mi/ln)
Two-lane highways	Time delay (percent)
Signalized intersections	Control delay (sec/veh)
Unsignalized intersections	Control delay (sec/veh)
Urban streets or arterials	Average travel speed (mph)

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Monitoring Traffic Flow

Freeway LOS Categories

LOS	Density range
A	0-11
B	>11-18
C	>18-26
D	>26-35
E	>35-45
F	>45

Transportation Research Board (2000). Highway Capacity Manual (Washington, D.C.: National Research Council).

Two-lane Highway, Class I - LOS Categories

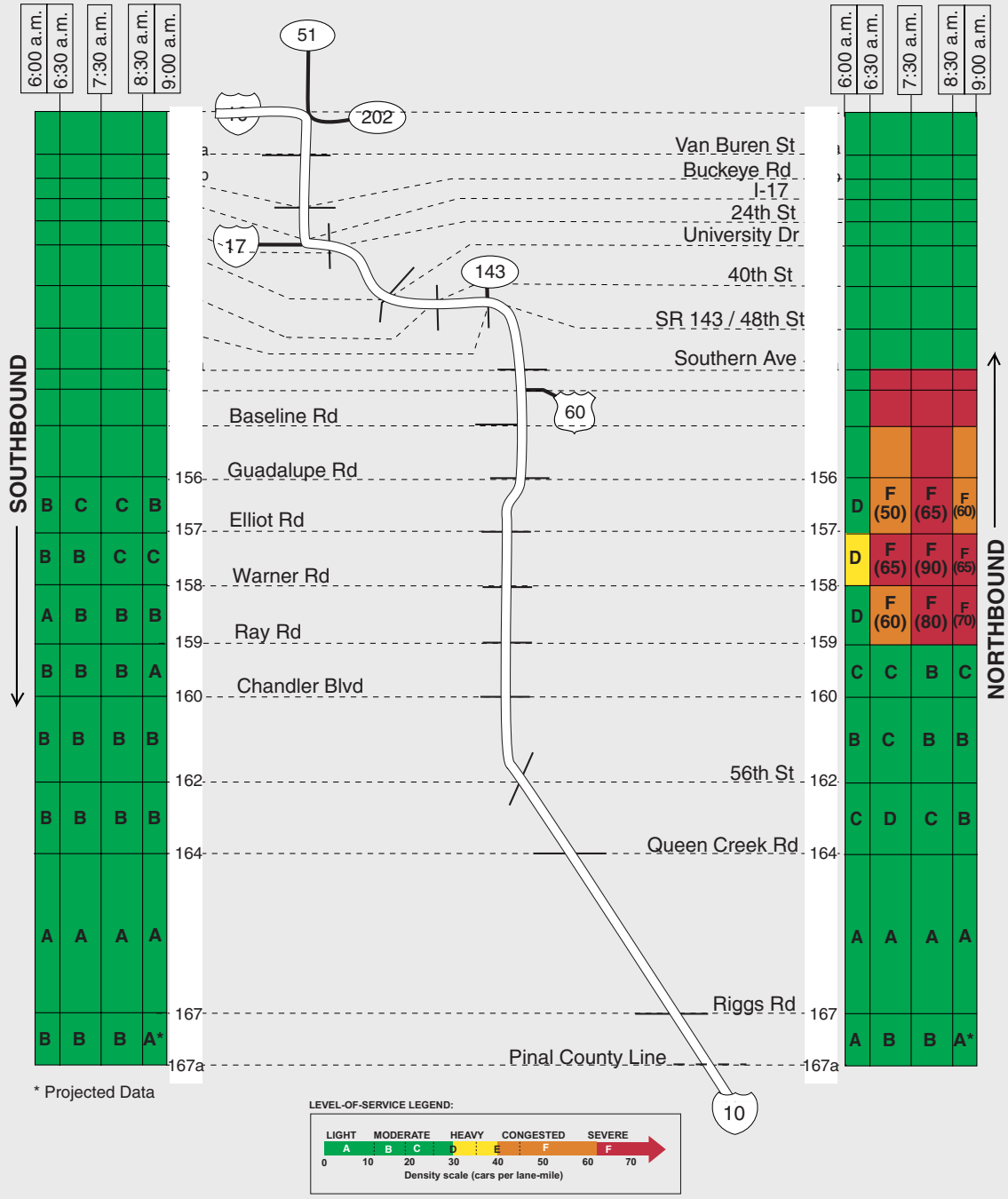
LOS	Percent time following	Average travel speed (mi/hr)
A	0-35	>55
B	>35-50	>50-55
C	>50-65	>45-50
D	>65-80	>40-45
E	>80	0-45

Transportation Research Board (2000). Highway Capacity Manual (Washington, D.C.: National Research Council).

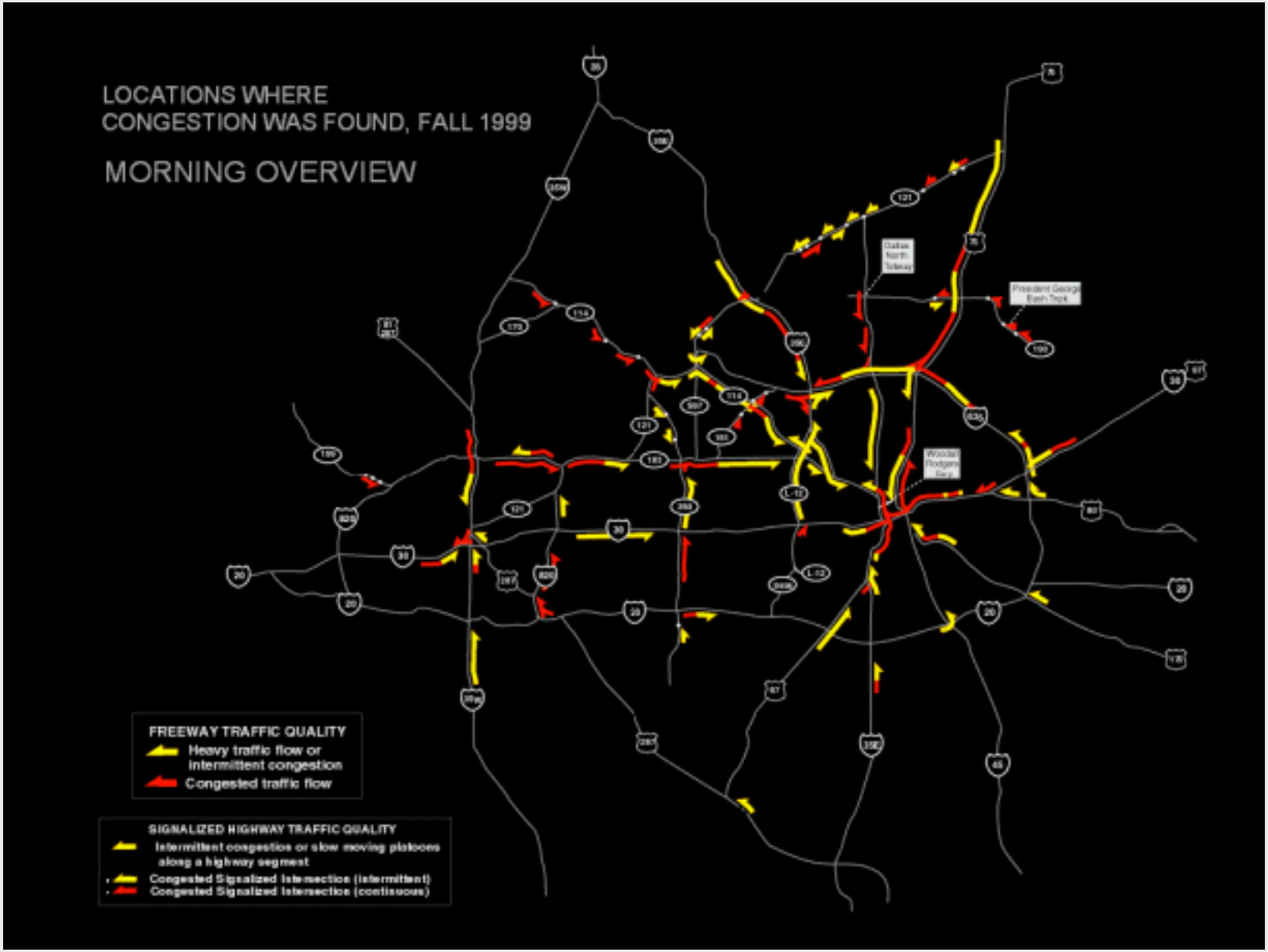
Reported Roadway Segment LOS

Begin time	Segment 1	Segment 2	Segment 3	Segment 4	…	Segment *n*
6:30 am	A	A	A	A		A
7:00 am	A	B	B	A		A
7:30 am	B	C	D	F		C
8:00 am	C	D	F	F		F
8:30 am	D	D	F	F		D
…						

Integrating LOS Across Time and Space



Service Quality Along Segments



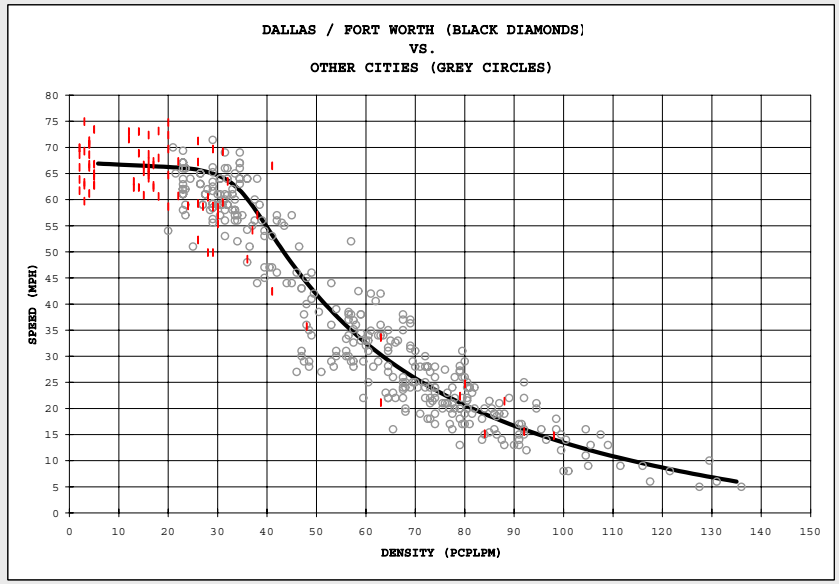
Associated Companies

- Skycomp, Inc.
  - 5999 Harper's Farm Rd., Suite E-225, Columbia, MD 21044
  - Phone: (410) 884-6900
  - Web: www.skycomp.com
- Contact: Greg Jordan
  - jordan@skycomp.com

- PAR Government Systems (Geospatial Services and Products)
  - 314 South Jay Street, Rome, NY 13440
  - Phone: (315) 339-0491 ext. 276
  - Web: www.pargovernment.com/web/pargov.html
- Contact: Lynn Taylor
  - lynn_taylor@partech.com

Agency/Organizational Issues

- Aerial photography
  - flexible and economic approach for measuring level of operation, determining the existence and extent of congestion (both time and distance), and identifying sources of congestion
  - permanent record of observed conditions at a particular point in time
- Congestion and LOS



Agency/Organizational Issues (cont)

- Orientation to support planning processes
- Communicating regional traffic conditions to elected officials and the public in a non-technical way
- Broad spatial coverage
  - multi-jurisdictional or multi-state
- Safty
  - weaving studies
- Longer term thinking
  - every 3-5 years
  - ability to link survey findings and improvements/changes
- Duration and variation of congestion
  - time of day
  - day of week
  - month of year

National Consortium on Remote Sensing in Transportation (NCRST)

- Report associated with this project should be released soon
- www.ncrst.org